SIXTH ANNUAL REPORT

OF

RUTGERS'

SCIENTIFIC SCHOOL.

1870.

TRENTON, N. J.:
PRINTED AT THE TRUE AMERICAN OFFICE.
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REPORT OF THE TRUSTEES.

To His Excellency Theodore F. Randolph, Governor of the State of New Jersey:

SIR:—I beg leave in behalf of the Trustees of Rutgers' College, to submit the sixth annual report of Rutgers' Scientific School, in accordance with the requirement of the fourth paragraph of section fifth of the act of Congress, approved July 2, 1862, and section fifth of the act of the Legislature of the State of New Jersey, approved April 4, 1864.

Since the date of the last annual report, several changes have been made in the organization and equipment of the Scientific School; the most important of which are an increase of the Faculty of Instruction, an extension of the two principal Courses of Study from three years to four; (to take effect in September, 1871,) and a rearrangement and enlargement of recitation rooms. These changes which will be more particularly noticed under their appropriate heads, constitute a valuable addition to the facilities for instruction previously afforded by the Institution, and give it an encouraging prospect of increased usefulness.

I. FACULTY OF RUTGERS' SCIENTIFIC SCHOOL.

The Faculty is now constituted as follows:

Rev. William Henry Campbell, D. D., LL. D., President, and Professor of Moral Philosophy.

George H. Cook, Ph. D., LL. D., Vice President, and Professor of Chemistry, Natural History and Agriculture.

David Murray, A. M., Ph. D., Professor of Mathematics, Natural Philosophy and Astronomy.

Rev. Theodore S. Doolittle, Professor of Rhetoric, Logic and Mental Philosophy.

Colonel Josiah H. Kellogg, Brevet Major, United States Army, Professor of Military Engineering, and Military Superintendent.

John Conover Smock, Professor elect of Mining and Metallurgy.

George W. Atherton, A. M., Voorhees Professor of History, Political Economy and Constitutional Law.

Rev. Carl Meyer, D. D., Professor of French and German.

Francis Cuyler Van Dyck, A. M., Professor elect of Analytical Chemistry.

Edward A. Bowser, B. S., Adjunct Professor of Mathematics.

Isaac E. Hasbrouck, A. M., Tutor in Mathematics.

Professor Cook, during the present year, has spent several months in Europe, in the interest of the Agricultural College and the State Geological Survey; examining the mining and agricultural operations and the Scientific Schools of England, Holland, France, Sweden and Germany. He is expected home in time to resume his duties here at the beginning of the coming Winter term.

Since the last report was made, the trustees have completed the endowment of the chair of Mining and Metallurgy in the Scientific School, and established the additional chair of Analytical Chemistry. Professor Smock, formerly Assistant State Geologist, who had previously been elected to the former chair, is expected to return from Germany in season to assume its duties at the beginning of the Winter term.

The Professorship of Analytical Chemistry has been filled by the appointment of Mr. Van Dyck, who has been connected with the Scientific School for several years as Tutor in Chemistry. Professor Van Dyck is now extending his studies in Europe, where he has leave of absence for a year.

A further addition to the teaching force of the School has been made by the appointment of Mr. Edward A. Bowser, as Adjunct Professor of Mathematics. Professor Bowser is a graduate of the School, and has been employed since taking his degree, a portion of the time as Tutor here, and, more recently, on the Geological Survey of this State, and the United States Coast Survey.

II. COURSES OF STUDY.

The Scientific School provides two principal Courses of Study, either of which the student my elect for himself:

1. A COURSE IN CIVIL ENGINEERING AND MECHANICS.
2. A COURSE IN CHEMISTRY AND AGRICULTURE.

These courses are hereafter to extend through four years. The studies of the first two years are the same in both, and are arranged with particular reference to the wants of those who desire, within a limited time, to prepare themselves as Land Surveyors or practical workers in any department of industry.

A shorter SPECIAL COURSE IN CHEMISTRY, extending through only two years is also provided to meet the wants of such students as wish to devote themselves exclusively to that branch.

In addition to these regular courses, provision is made for PARTIAL

STUDENTS, who may enter at any time and select, under the direction and advice of the Faculty such studies as they may be found qualified to pursue with classes already formed, subject to the general regulations and discipline of the institution, and to such examinations as may be prescribed in each case. Such students, on leaving the institution, receive certificates stating the studies pursued, and the attainments made. Students completing either of the four years' courses, receive the degree of Bachelor of Science.

III. TERMS OF ADMISSION.

Applicants for admission to the full courses of study must be sixteen years of age, of good moral character, and must pass a satisfactory examination in English Grammar and Spelling, Geography, Physical Geography, History of the United States, Arithmetic, Algebra to Equations of the Second Degree, and three books of Plane Geometry. The regular examinations for admission are held on the Saturday, Monday and Tuesday, preceding the annual commencement, and on the day preceding the opening of the fall term.

Candidates for advanced standing are examined, in addition to the preparatory studies, in those already pursued by the class they propose to enter.

IV. STUDENTS AND STUDIES.

The classes now in the Institution are:

First—The class organized in September, 1868, which will be graduated in June, 1871.

Second—The class organized in September, 1869.

Third—The class organized in September, 1870.

The first class now consists of nine students, the second of fourteen students, and the third of twenty-seven students, making a total of fifty.

There have been in the Institution during the year, sixty-one students, of whom eleven were from the State of New York; one from Japan, and the remaining forty-nine from the State of New Jersey, presenting the counties as follows:

Bergen	county,	2
Cumberland	"	1
Essex,	"	8
Gloucester,	"	1
Hudson,	"	1
Mercer,	"	2
Middlesex,	"	12
Monmouth,	"	5
Morris,	"	4

Salem,	"	1
Somerset,	"	5
Union,	"	7

The studies of each class, as arranged for the new course of four years, are given in full in the Appendix to this report. The general scheme does not differ materially from that pursued by students now in the Institution, but it has been somewhat enlarged and more carefully graded, so that while the over pressure of work will be considerably relieved, the education furnished will be more complete, more thorough and more varied.

The extension of the course to four years was determined upon after very mature deliberation and with great unanimity by the Board of Trustees, and the State Board of Visitors, and important benefits are expected to result from the change, more time will be secured for actual field practice in surveying and engineering, and for the practical manipulations of the laboratory; and the leading studies of the course, which had proved to be too numerous and difficult for the time allowed them before, can now be more fully and satisfactorily taught.

There can be no doubt that the increase of range and thoroughness, and consequent value, thus given to the course will be far greater than in proportion to the increase of time. It is believed, too, that the large introduction of studies of a general educational, rather than a purely technical character, which is made possible by the extension of the course, will do much to make our graduates better educated men, as well as better trained specialists.

It is gratifying to be able to state that the standard of discipline and scholarship in the Institution is steadily improving and that its general condition is now better than at the date of any previous report.

The class that entered at the beginning of the present academic year is nearly twice as large as any previous one, and represents a larger portion of the State than any other has ever done. Nine counties, however, are still unrepresented, as will be seen from the table above. It is hoped that the attention of the County Superintendents of Schools, on whose recommendation the State Scholarships are filled, may be called to the importance of having their young men avail themselves of the privileges here offered them by the State.

V. THE LAST GRADUATING CLASS.

At the last Commencement of the College, in June, 1870, the graduating class consisting of six members, was admitted to the degree of Bachelor of Science. Theses were prepared by them and read before the State Board of Visitors on the following subjects:

William Clark, Matawan, N. J., "The Bridge over the Raritan at New Brunswick."

Charles C. Haven, Jr., Trenton, N. J., "Pneumatic Transit."

Harry C. Ives, Newark, N. J., "Roads; with an account of the Telford Road, near Orange, N. J."

George E. Sealy, Newark, N. J., "Mines."

Douwe D. Williamson, New Brunswick, N. J., "Bridges; with an account and calculation of strains on a bridge over the Raritan, near New Brunswick."

John S. Ferguson, New Brunswick, N. J., was excused from the preparation of a thesis, on account of sickness.

The two prizes offered by the Professor of Mathematics for the best theses, were awarded: the first to Mr. Clark; the second to Mr. Haven.

A prize of one hundred species of minerals offered by the Professor of Chemistry to the member of the Graduating Classes, who should be able to identify and name the largest number of them was awarded to Mr. Clark.

Two of the class are now pursuing special studies; the other four are engaged in various pursuits in the State of New Jersey, one is farming; one in real estate business; one on the Mercer and Somerset Railroad, and one in the Jersey City Surveyor's office. Our graduates find no difficulty in securing honorable and remunerative employment.

VI. MILITARY DEPARTMENT.

Besides the instruction given to the graduating class in Military Engineering and Field Fortifications, the members of all the classes are drilled by the Military Superintendent in the Autumn and Summer terms, in Infantry Tactics, including the manual of arms. The arms and accoutrements furnished by the State for this purpose, are properly cared for in the armory provided by the trustees, and are now in good condition.

VII. AGRICULTURAL DEPARTMENT.

A full report of the condition and operations of this department will be furnished by Dr. Cook. It is only necessary to state here, that the results of plentiful fertilizing, careful cultivation, and underdraining when necessary, are each year becoming more manifest on the college farm, and are fully justifying the wisdom of the methods pursued by the Professor of Agriculture.

VIII. IMPROVEMENTS IN BUILDINGS, &C.

During the last summer vacation several of the recitation rooms

were enlarged and thoroughly refurnished, but still further accommodations are needed at once. The Trustees have decided to erect a new Geological Hall, containing rooms for recitations, a Geological Museum, and other purposes. The College already possesses valuable collections which will be still further increased within a few weeks by a valuable donation presented by the will of the late James B. Laing, Esq., of Kinderhook, New York.

The amount received from the State Treasury for the fiscal year ending October 31, 1870, is six thousand nine hundred and sixty dollars ($6,960); which has been expended exclusively for the salaries of the Professors in the Scientific School.

All of which is respectfully submitted.

WILLIAM H. CAMPBELL,
President of the Board of Trustees.

New Brunswick, N. J., Nov. 24, 1870.

APPENDIX.

APPENDIX A.

COURSES OF STUDY.

[Adopted to go into effect September, 1871.]

1. COURSE IN CIVIL ENGINEERING AND MECHANICS.

FRESHMAN YEAR.

First Term.

1. French.
2. Mathematics—Loomis' Algebra, from Quadratic Equations.
3. Physiology—Dalton's.
4. Rhetoric—Haven's. Composition and Declamation.
5. Draughting—Construction of Problems.

Second Term.

1. French.
2. Mathematics—Loomis' Geometry, from Book IV.
3. Zoology—Agassiz and Gould's.
4. Elocution—Lectures, Composition and Declamation.
5. English Literature—Shaw's Manual.
6. Draughting.

Third Term.

1. French.
2. Mathematics—Loomis' Trigonometry, Plain and Spherical.
3. Botany.
4. English Literature—Shaw's Manual.
5. Draughting. Composition and Declamation.

General exercises during the year in Composition and Declamation. Bible Class on the Sabbath.

SOPHOMORE YEAR.

First Term.

1. Descriptive Geometry and Surveying.
2. Chemistry—Lectures.
3. Mental Philosophy—Haven's. Composition and Declamation.
4. Modern History—Weber's Outlines.

Second Term.

1. Descriptive Geometry and Road Making—Gillespie's.
2. Chemistry—Lectures.
3. Mental Philosophy—Haven's. Composition and Declamation.
4. Modern History—Weber's Outlines.

Third Term.

1. Leveling and Railroad Curves—Henck's Field Book. Field Practice.
2. Shades, Shadows and Perspective.
3. Chemistry—Lectures.
4. Mental Philosophy—Lectures. Composition and Declamation.
5. Creasy's Constitutional History of England.

General exercises during the year in Composition and Declamation. Bible Class on the Sabbath.

JUNIOR YEAR.

First Term.

1. German.
2. Analytical Geometry—Church's.
3. Natural Philosophy—Silliman's Physics.
4. History of Civilization—Guizot's; and Constitutional History of the United States—Lectures.

Second Term.

1. German.
2. Calculus.
3. Natural Philosophy—Silliman's Physics.
4. Political Economy and Constitutional History of the United States.

Third Term.

1. German.
2. Analytical Mechanics—Bartlett's.
3. Astronomy—Lockyer's.
4. International Law—Woolsey's.

General exercises during the year in Composition and original Declamation. Bible Class on the Sabbath.

SENIOR YEAR.

First Term.

1. Analytical Mechanics—Bartlett's.
2. Geodesy—Theory and Practice of Triangulation.
3. Chemistry—Lectures.
4. Moral Philosophy.

Second Term.

1. Civil Engineering—Mahan's.
2. Geodesy; Practical Astronomy; Indeterminate Analysis.
3. Chemical Physics—Lectures.
4. Moral Philosophy.

Third Term.

1. Civil Engineering—Mahan's. Railway Practice.
2. Architecture—Lectures.
3. Geology—Lectures.
4. Moral Philosophy.

General exercises during the year in Composition and original Declamation. Bible Class on the Sabbath.

II. COURSE IN CHEMISTRY AND AGRICULTURE.

[The first two years the same as in Civil Engineering and Mechanics.]

JUNIOR YEAR.

First Term.

1. German.
2. Analytical Geometry—Church's.

3. Natural Philosophy—Silliman's Physics.
4. History of Civilization—Guizot's; and Constitutional History of the United States—Lectures.

Second Term.

1. German.
2. Analytical Chemistry, with Laboratory Practice.
3. Physics and General Chemistry—Lectures on Agriculture.
4. Political Economy and Constitutional History of the United States.

Third Term.

1. German.
2. Analytical Chemistry, with Laboratory Practice.
3. Vegetable Physiology.
4. International Law—Woolsey's.

General exercises during the year in Composition and original Declamation. Bible Class on the Sabbath.

SENIOR YEAR.

First Term.

1. Mining and Metallurgy.
2. Geodesy.
3. Chemistry and Principles of Agriculture—Farm Accounts.
4. Moral Philosophy.

Second Term.

1. Agriculture—its methods and products.
2. Geodesy and Practical Astronomy.
3. Chemical Physics—Lectures. Laboratory Practice.
4. Moral Philosophy.

Third Term.

1. Animal Physiology.
2. Architecture—Lectures.
3. Geology—Lectures.
4. Moral Philosophy.

General exercises during the year in Composition and original Declamation. Bible Class on the Sabbath.

III. SPECIAL COURSE IN CHEMISTRY.

FIRST YEAR.

First Term.

1. Elements of Chemistry—Text Book and Lectures.
2. Blowpipe Analysis.
3. Elements of Mineralogy.

Second Term.

1. Physics and Chemistry—Text Book and Lectures.
2. Chemical Analysis—Qualitative.

Third Term.

1. Chemical Analysis—Qualitative and Quantitative.
2. Vegetable Physiology.

SECOND YEAR.

First Term.

1. Chemical Analysis—Analysis of Minerals, Ores, &c.
2. Mineralogy—Determinative.

Second Term.

1. Chemical Physics—Heat, Electricity, Magnetism, Galvanism and Electro-Magnetism—Text Book and Lectures.
2. Analysis of Fertilizers and Chemical Products.

Third Term.

1. Lectures on Geology.
2. Chemical Analysis—special investigations.

APPENDIX. B.

REPORT *upon the Farm of the Agricultural College*; NOTES *of visits to Farms in Europe, in* 1870, *and* REPORT *on the progress and present condition of Agricultural Education in Europe, by* GEORGE H. COOK, *Professor of Agriculture.*

By the favor of my associates in the College Faculty, and with the permission of the Trustees, I have made a tour through several countries of Europe, during the past summer and autumn,—and have been enabled to study their agriculture, and to get some more definite information upon the subject of Agricultural Education. The lateness of my return has prevented my notes being embodied in the Agricultural College Report,—and compels their appearance in the appendix. The several parts of my returns are arranged under the titles given at the head of this article.

I. REPORT UPON THE AGRICULTURAL COLLEGE FARM.

The following is a brief statement of the present condition of the farm, and of the operations carried on upon it during the last year.

As stated in former reports the farm contains ninety-nine acres. It was originally an old style farm with perhaps one-third upland, naturally drained and easily cultivated, but poor; one-third in pasture, the land too wet to be cultivated, poor, sour and unproductive; and the remaining third also wet, but uncleared, having been used to furnish fuel for the farm house and to eke out by the sale of wood, a family support, which the ordinary produce of the cultivated land did not yield.

The location of the farm in the borders of New Brunswick, within a mile and a half of the College, and its capability of improvement led the Trustees to select it for the uses of the Agricultural College. The work of clearing up the new land, draining that which was too wet, enriching the whole and bringing it into productive cultivation has been steadily going on through the five years since it was purchased.

The first two or three years' work were so spread out in cutting

bushes, clearing out hedge-rows, and draining the wet grounds, that it must all be counted as preparatory, and rather undefined labor.—The farm is now getting into such condition that the Trustees are satisfied it has fairly begun the work expected of it by the State; and that in the preparing of the land itself, in its cultivation, its enrichment, its crops, its stock and its implements, it is successfully at work for the improvement of Agriculture, and upon all these points we have something worthy the attention of inquiring farmers. There is much still to be done, in all the points mentioned, and in the buildings, fences, roads and embellishments which taste would require, and which are needed to make a farm attractive, we are still deficient. But year by year we hope to go on filling up our deficiencies, and advancing with the improvements of the country and the age.

The last of the uncleared land has been plowed this year, and without interference with the ordinary work of the farm will be ready for a crop of buckwheat or rye next year. It is a field of about eight acres, the most remote part of the farm, and this brings all the land under the plow and in course of productive cropping.

The stumps in the new ground, though old, were large and very numerous. Last winter we took them all out from a field of twelve acres, and this winter we have begun the clearing of about twelve acres more, and shall have it done in season to plough the ground for corn. This is a very heavy expense, and one that farmers may well dread to meet. It is more felt than the ordinary one of spreading the work of final clearing over fifteen or twenty years, but in the end it will be found the best way. The work of pulling stumps has been made comparatively easy by the use of Pressey's Pioneer Stump Puller. This inexpensive machine is really a wonder for its power, its simplicity and its successful working in the hands of common laborers; it has saved half the cost of grubbing. The inventor of this machine, Mr. G. W. Pressey, of Hammonton, New Jersey, has by his invention increased the value of every acre of uncleared land in the State.

As the land is cleared and plowed, the portions requiring drainage are better defined, and each year gives new proof of the great value of this improvement in modern agriculture. This year we have put a six inch tile drain in the large open ditch which crossed the farm, and have laid about one thousand and four hundred feet of underdrains in the new fields on its south end. The land is very flat and heavy. In such ground the advantage of drains two and a half or three feet deep over those only two feet deep, is very plainly marked by the increased dryness of the soil. We have laid only round tile, and all the smaller sizes have rings over the joints. The tile used this year are in two feet lengths, and are supplied from the factory of C. W. Boynton & Co., of Woodbridge. They are of the first quality, and all the drains are working well. In some of the drains we have laid tile only one and a quarter inches in diameter. So far

they are sufficient to carry all the water, and it is confidently expected that they will prove sufficiently large at all times. If so, it makes a considerable saving, both in the cost and in the expense of hauling and handling.

In the cultivation of the soil we have not advanced in our methods much beyond those in common use. We have done ploughing for next spring's crops as far as possible, aiming to break up the ground as deeply and thoroughly as we can, and not to bring up the subsoil; but to keep the richest earth and the manure as near the suaface as possible. We have used for this ploughing Holbrook's Stubble Plough No. 69, the same which received the highest prize of the New York State Agricultural Society, at the great trial of ploughs held at Utica, in 1867. The plough needs three horses to pull it, and ploughs eight, nine, ten or even twelve inches deep, thoroughly pulverizing the soil and leaving it in excellent condition for the action of the winter's frost.

To thoroughly cultivate the soil without inverting it, is of the highest importance, and it is designed to pursue experiments in this direction until we get the best implements and the best way and time for doing the work.

For ordinary ploughing the cast cast-steel ploughs of Collins & Co., are preferred to all others by our workmen, on account of their light draught.

Of fertilizers, the best we can get is barnyard manure, and every expedient we can avail ourselves of to increase the supply is resorted to. Our plan is to keep all the stock the farm will support, and in addition we purchase in town. The fertilizer next in importance is greensand marl. This we apply in compost upon our potatoes, and as a topdressing upon grass lands. Its effects are most marked in the increased crops of hay, and now, as we begin to break up the sod ground which has been marled and that which has not, the succeeding crops show a most striking difference. In trial plots where marl was put on the sod four years ago, with the effect of doubling the grass crop ever since, the oats upon them this year were very conspicuous, being fully twice as large on the marled as on the unmarled plots. The same result has also been seen with corn in former years. Much as this fertilizer has been used, its real value is not fully known yet. It needs a little time to get its full benefit, but when once fairly in action on a farm it is almost inexhaustible. Some of the more concentrated manures have also been used. Guano and super-phosphate of lime have been used upon cabbage and turnips, and they more than pay their cost in the single crop. A compost of hair, stable manure and fine earth was used upon some of the cabbage, and its effects compared well with the guano. Some trials with fertilizers upon wheat were also made. The most striking effects were produced by the use of sulphate of ammonia: a topdressing of this fertilizer in April gave a most remarkable spur to the growth of blades and straw.

This substance and nitrate of soda are among the quickst fertilizers known. Thin spots in wheat or meadows, or a poor growth of grass upon lawns can be greatly improved in the Spring by a dressing of from two to four hundred pounds to the acre.

The crops are the ordinary staples, varied slightly, of course, by our nearness to the city and to markets, which gives some advantage in favor of those which are heavy or perishable. Of wheat we raised but little, the blue stem red wheat, was of excellent quality; the Tappahannock white wheat, was again damaged by rust, so that we have twice failed with it. A third trial of the variety is in progress, and if this fails we shall abandon it. Larger crops of wheat should be raised by our farmers, and it is difficult to tell why they are not. They seem fairly within the reach of skillful tillage, and yet our crops do not generally exceed twenty bushels an acre, and in the majority of cases fall short of it. The average crop in Great Britain is about thirty bushels. I have seen thousands of acres of wheat in England this year which would average forty bushels, some which would average forty-eight bushels, an occasional field which would average fifty-six bushels, and one farm in Lincolnshire, which had three hundred acres of wheat, averaged fifty-six bushels to the acre, and some of its fields yielded sixty-four and sixty-eight bushels per acre. The crops there were formerly much less than now, though I presume they were always larger than ours. They manure heavily, generally on the preceeding crop; the time of sowing is indifferent, any time in October or November will answer. Both red and white wheat are raised, bearded and bald. The ploughed ground for the wheat is rolled solid, the wheat is drilled in, and the surface made mellow and fine by the use of a light harrow with numerous small teeth. The wheat is cultivated in the spring; the straw stands well and is not very liable to rust. Are those superior crops due to peculiarities of soil or climate, to better varieties of wheat, or to more skillful cultivation? We must try to find out. With barley, the trials made for two years past, have not been encouraging. The oat crop was a very fair one, seven acres of Norway oats averaging fifty-two bushels of twenty-six pounds each, per acre, and three and a half acres of Surprise oats yielded forty-three bushels of thirty pounds each. A part of the land was very poor, and had not been ploughed before since the farm was bought. Indian corn was cultivated on nearly twelve acres of ground; it suffered from drought and only a medium crop was obtained. Three varieties were cultivated, the large dent corn from David Petit, of Salem county; a medium sized dent corn that has been cultivated in this vicinity for many years, and the white flint, Sandford corn. On good ground and with a favorable season the Petit corn is the most productive; it takes a longer time to mature, and for two past seasons has been hurt by drought, and still it yielded about the same as the other, and three years ago it

was decidedly better. The Sandford corn has not yielded well in grain or stalks, and I think it is not adapted to our soil or climate.

Potatoes were cultivated on five and a half acres of ground, and were manured both broadcast and in the row. They were somewhat damaged by dry weather, but yielded two hundred bushels to the acre. The Early Goodrich, Early Mohawk, Manhasset, Kidney, Jackson White, Chili Red and the Monitor were the varieties raised. Of these the Early Mohawk was the earliest and best in quality; the Early Goodrich yielded a large crop, with tubers of good size and fine quality. All the others were later and were checked by the drought, small in size, and some of them took a second growth and were injured in quality.

Two acres of long orange carrots were raised and the yield was four hundred bushels to the acre. The only difficulty in cultivating this crop occurs when it first starts; it is liable to be choked with weeds, and the clearing is both expensive and troublesome. The cultivator should be started as soon as the rows can be seen, and the weeds destroyed before they get much strength: in this way the crop can be profitably raised. Two acres of mangolds were also raised, half of the long red variety, and the other half of the yellow globe; the varieties are equally good. The crop was about four hundred bushels to the acre. An acre of ruta-bagas sown early was entirely spoiled by the dry weather. Two and a half acres sown later in the season yielded a large crop of roots of excellent quality.

Nearly twenty acres of the farm were in clover and timothy; the crop of hay was very good. An acre of sowed corn was also raised to supply green fodder for the milch cows; it answered the purpose well, and it is designed to have a succession of sowings in the future.

In market gardening we have raised three acres of cabbage, and the crop has been a paying one. A half acre of asparagus has been kept in three years, and a moderate crop obtained for two years, but the ground can be put to better use, and we have ploughed it up.

Small fruits—strawberries, raspberries, and blackberries—have been cultivated for market, but for two years past the market has been overstocked, especially with blackberries; the prices have been low, and there has been no profit to us on this crop. We shall not continue the business.

The farm is stocked with horses, mules, cattle and hogs—no sheep. The horses and mules are ordinary team animals.

The cattle are nearly all pure-blooded Ayrshires. There are seven cows and a bull of this breed; also a yearling heifer and bull, and two heifer and two bull calves. This breed of cattle is famed in its native country for its milking qualities, and as we keep cows to supply milk in the town, such a breed is of special value. As yet we have not a sufficient number to supply our wants, and four common cows are kept; but with the young animals now coming on, we shall soon have the entire herd of this breed. We raise all the calves, and

offer young animals of this breed to those who may wish to purchase them. They prove to be good milkers here, and we shall be interested in seeing the breed generally introduced. The business of supplying milk to our towns and cities is a very large and important one, and is likely to be much increased in the future.

The breed of hogs we are beginning to raise is the Poland-China, sold us by Dr. A. D. Newell, of this city. The breed has been tried at the West and liked; it is remarkable for attaining an enormous size, and also for being always fat when well kept. With these qualities it is constantly ready for market, and may be slaughtered at six months, a year, or two years old, with profit. Thus far the breed is fully equal to its reputation, both for rapid growth, and for continually being fat. We propose to do all we can to introduce it among our farmers.

During the coming year we hope to add specimen animals of the Short-horn and Dutch cows, and of the Southdown sheep. We keep also a stock of pure-blooded Brahma fowls and Cayuga ducks.

The farm buildings are such as were upon the farm when it was purchased. The increased crops require larger accommodations, and more stable room is needed for the stock, but it will be possible to add these necessary buildings to much better advantage when the land is in full crops and the requirements of the farm are more clearly defined.

The stock of implements is not large, but we are gradually adding those which are essential and generally approved. These important aids to agricultural improvement should be here in their most perfect forms. Some of our public-spirited merchants and manufacturers have supplied us with first class implements of various kinds, and it would be to the interest of every manufacturer of implements to deposit with us a working specimen of the articles he desires to sell.

DONATIONS.

From the Freehold and Squankum Marl Company, one hundred and fifty tons of their marl, delivered at New Brunswick.

From S. B. Conover, of West Washington Market, New York City, a barrel of Early Mohawk Potatoes.

From S. B. Conover, of West Washington Market, New York City, two hundred roots of Conover's Colossal Asparagus.

From F. F. Holbrook & Small, Boston, Massachusetts, a large Holbrook plough with separate mould boards for stubble and sod.

From G. W. Pressey, of Hammonton, New Jersey, we have received the loan of his Pioneer Stump Puller during the year.

A. S. Fuller, of Ridgewood, Bergen county, has given us one hundred and twenty currant bushes, comprising the following varieties selected by himself as the best for general culture, viz:

50 Red Dutch.

12 White.
12 Black Naples.
6 Knights.
6 Versailles.
20 Cherry.
14 Fertile de Palluan.

The Trustees gladly acknowledge the liberality of these donors. Without undertaking to advocate the interests of any private enterprise, or to speak well of that which is not approved, they are still free to present the advantages of anything they judge meritorious; and it will become more and more the business of the Agricultural College to do this in their reports to the public.

The bringing up of poor land is a slow and expensive work. Five, ten, fifteen, and even twenty years have been spent by able and enterprising farmers in improving their farms before any profits could be taken for other uses than those of the farm. The patience of many fails in this preparatory work, but every one who is to succeed must go through it. The Agricultural College farm furnishes no exception to this principle; its friends have been patient, and we may hope that its power for teaching has begun.

With more time to prepare this report, a greater number of figures could have been given. Records of the farm and stock, and their produce are kept, and from year to year we shall attain greater fullness and accuracy of detail, and be able to publish reports of a more statistical character.

ON AGRICULTURAL EDUCATION IN EUROPE.

The importance of bringing in learning and especially physical science to the aid of Agriculture is everywhere acknowledged. The advantages to be gained are appreciated by all. The way to secure them is not so plain. Whether the successful young farmer is to learn by the drill of a farm, under the guidance of a farmer,—by a training in business—by listening to lectures on Agriculture—by a course of study in physical sciences, or by a liberal education is still questioned. Each of these plans has its advocates and various institutions for teaching agriculture, are more or less modified in their plans as one or other of these views prevails.

With a full and free comparison of the practical working of these plans a few years must show the friends of agriculture the best way of training farmers and improving their art.

In the course of the tour made, Agricultural Colleges were visited in Norway, Sweden, Denmark, Germany, England and Scotland, and information was collected about many others.

The Norway Agricultural College is at Aas, twenty-one miles south of Christiania. It was visited on the last day of August. The drive was over an excellent macadamized road, but in the whole dis-

tance there were not a half dozen farms on which a comfortable living could be made. The weather was bright and pleasant, though frost had already been felt and tender crops like potatoes had been killed.

The College buildings are located upon a farm of three hundred acres, and are intended to provide for thirty-two students. The College is supported by the government, and the students are received from the different provinces. The qualifications for admission are that that the candidate shall be eighteen years old, confirmed in the Lutheran Church, and pass a satisfactory examination in reading, writing, geography, history, arithmetic and plane geometry. Their course of instruction covers two years, and there is only one class at a time students being admitted every other year. The subjects of study are Chemistry, Physics, Botany, Forestry, Veterinary Science, Drawing, Surveying, Leveling, Bookkeeping and Farm records, together with practical work and implement making.

The teaching force consists of the Director, who is the Farm Manager, a Professor of Agriculture, a Professor of Agricultural Chemistry, a Professor of Veterinary Science, and a Professor of Forestry and Botany.

There were only fifteen students in attendance, the other scholarships not being filled. The fees are one hundred Norwegian dollars, ($107.77) for each student per year for tuition, rooms and board. The students may work or not, as they choose; the rates of pay for their work are fixed, and the student may earn sixty dollars a year by farm labor, if he improves all the time. The first students came there in 1859, and the graduates have not been out long enough to make much impression on Norwegian Agriculture. The faculty is an able one and their work is well done, but I do not think the College has much hold on the people. The farm occupied is in fine condition; it was originally a stony, poor, and wet tract of land, producing nothing but birches and Norway spruce, and, when cleared, yielding only moderate crops of rye, oats, barley, potatoes and grass. The stones have been cleared off (50,000 cart-loads), the ground thoroughly under-drained with tile made on the farm, artificial manures have been used to enrich the soil, good crops of wheat, as well as of the other grains, have been raised, the meadows of cultivated grass are dry, warm and luxuriant, and a herd of fifty fine Ayrshire and Norwegian cows supply the milk for a model dairy. There is hope in this farm for poor, cold Norway. If it were located near Christiania, where it could come under the eyes of the Storthing (parliament), and of the enterprising and liberally educated people of the country, it would do a noble work. To see those cold soils naturally producing only birch, or oats and sour grass, warmed by under-draining, and tilled to successfully grow wheat, must convince the most incredulous, and the people who, with a population of a million and a half, support seven hundred students at the University

of Christiania, would not be slow to learn from, and to sustain an institution which brings such benefits to their knowledge.

Besides the Agricultural College, there are farm schools in every province where laboring young men can be practiced in the best methods of farming, and be taught the elements of science.

In Sweden there are Agricultural Schools and selected farms in every province where young men are received, taught the best methods of farming, and required to work steadily. In the winter evenings they are instructed in the common branches of education and in the elements of natural science. Besides there are two Agricultural Colleges, each with a large farm, convenient buildings and appliances for giving the best instruction in agricultural science and practice, and a large experimental farm for the testing and dissemination of new varieties of seeds, fruits, trees, stock, &c. One of the Agricultural Colleges is located at Ultuna, three and one half miles south of Upsala, and the other in southern Sweden, at Alnarp, six and one half miles north of Malmo. The Experimental Farm is in the borders of Stockholm.

The College at Ultuna has a farm of one thousand acres, a faculty of eight resident and three special professors, and an attendance of about thirty students, with whom work is optional; twenty students who work every day; and six young women, practical students in the dairy department. The professorships are, Farm Economy; Practical Chemistry; Elementary and Agricultural Chemistry and Management of Animals; Anatomy and Physiology; Forestry, Surveying and Leveling; Farm Inspection and Management; Inorganic Chemistry; Book-keeping; Botany and Zoology; Physics, Meteorology and Mechanics; and Agricultural Law.

The highest class is composed of young men who are fitting for managing their own farms or those of others, or for teachers. For entrance they must be eighteen years of age, pass an examination on reading, writing, geography, history, arithmetic, algebra, plain geometry and the elements of botany and zoology. It is recommended also that they be acquainted with English and German, and that before entering they should have a year's experience on a farm. The course of study occupies two years, and formerly the students were only admitted every alternate year, but now they are allowed to enter every year. The fees are seven hundred and fifty rix dollars ($202.50) the first year, and six hundred ($162) the second year; and for this the student receives instruction, board, room rent, bed and fuel, but not washing or lights. Work is optional with them and they get no pay; but they are finally examined in the manipulations of farm work. They are mainly instructed by lectures, and their examination is strict. Since the institution was opened in 1849, there have been three hundred and sixty-five students, and two hundred and two of these have graduated. The graduates of this grade have usually found ready and satisfactory employment, but at present

there are some of the recent graduates unemployed, and they are desirous of finding places in this country. They are accomplished men and would come for very moderate pay at first.

The students of the second grade are those fitting themselves for stewards or foremen on farms. Only twenty four are received, twelve a year, and the places are all full. They must be healthy, twenty-one years old, have finished their military service to the government, and stand examination in reading, writing and the four ground rules of arithmetic. They work every day, and for it receive no money, but board, room, fuel and light, and two hours a day of instruction in winter. They are taught from text books in the theory and practice of agriculture, management of cattle, physiology and diseases of animals, veterinary science, arithmetic, geometry, writing and spelling. At the close of their course they are examined, and if passed receive certificates. This department is constantly full, and the graduates have always found immediate employment.

The Dairy School is for a one year's course, and only six girls are admitted to the class. They must be healthy, are usually about twenty years old, and must be able to read. They work every day in the dairy, milking, foddering, and cleaning the cattle and stables, and in making butter and cheese. In the winter evenings they are instructed in writing, ciphering, management of cows and calves, and in the diseases of cattle; at the close of the year they are examined and receive certificates. This department is very popular; there are forty applications for the six places this year. All the pupils find ready employment.

The College at Alnarp is located upon a farm of thirteen hundred acres of excellent land, and is supplied with large and well-planned buildings, both for the school and the farm. The visit was made there during vacation, and none of the Professors were at home. On this account I could not learn the particulars in regard to the Faculty and course of instruction. The institution is, however, upon the same general plan with that at Ultuna. There were twenty four students of the higher grade and thirty-six of the lower, both of whom are for the two years' course, and a number of students in horseshoeing in a three months' course. The institution is well spoken of, and its appearance is creditable.

The farms of both these colleges are well equipped and well managed, and are models for the country around them.

The experimental farm of the Royal Agricultural Academy near Stockholm is on a part of the Crown lands, set off by King Bernadotte for the purpose. It is in charge of Prof. C. Julien Dannfelt, a gentleman well known to agriculturalists in all parts of Europe, and well fitted, by his tastes and his attainments, to do justice to its interests. He has the farm stocked with the best cattle, sheep and swine, enriched by the most approved fertilizers, and cultivated with

the latest improved implements. He has also the best varieties of seeds, roots and other crops, as well as plants and trees, in cultivation. He is assisted by a good chemist, an accomplished gardener and intelligent foremen. He is an influential member of the Royal Agricultural Society of Sweden, and their reporter on European stock, and by his pen is continually before the Swedish public. Through these advantages he secures the best of everything in improved agriculture, and is able to sell the produce of the farm so as to make it both self-sustaining and a teacher to the nation. There are no students received. My impressions of this establishment were very favorable; its success is, of course, partly personal, but the plan is practically a good one. I should not neglect to acknowledge my obligations to Professor Dannfelt for the many attentions shown to myself and companions, as well as for the opportunity allowed to profit still further by correspondence with him.

The Agricultural and Veterinary College of Denmark is at Copenhagen. It is in charge of Professor B. S. Jorgensen, who, with great courtesy, showed me through the buildings and over the gardens and farm, explaining fully the theory and workings of the institution. It is supported by the government, and is largely attended. The buildings are in the outskirts of the city, upon a plat of about forty acres of ground. Full provision is made for teaching and experiments, but none for boarding or lodging students; they find accommodations wherever they choose in the city. The instruction is without charge, except in chemistry, for which a fee covering about half the cost of the chemicals is paid. Students of eighteen years old and over are admitted, and the ages of those attending range from eighteen to thirty. No special qualifications are required, but good order is strictly enforced, and a thorough examination must be passed in order to graduate. There are about two hundred and fifty students in attendance. The Veterinary department is a large and attractive part of the institution. There are infirmaries for horses, cattle, hogs, sheep and dogs, and patients are received from the city and country and treated by the professors. The professors and students also visit out-door patients; the museum of this department is a model of its kind. The departments of Chemistry and Botany are also admirably fitted up and provided with appliances for study, observation and experiment. The buildings, lawns, walks and shrubbery occupy a considerable part of the grounds; but there is room for an extensive botanic garden, in which are grown all the common varieties of cultivated plants, common weeds, shrubs, fruit and forest trees; also plants peculiar to clayey, sandy, calcareous, wet, dry, sunny, shady or other soils, and also plants growing in water. There is also a considerable area in small plots devoted to gardening, and arranged for the instruction of a class of gardeners. The plots for field crops are of good size, and are planned so as to show the effects of varied cultivation and different fertilizers, and the qualities of new

varieties of seed. It should be remarked of agricultural experiments that, while full records of them are kept, they are not allowed to be published until they have been conducted several years and reliable conclusions can be drawn from them.

Professor Jorgensen is President of the Royal Agricultural Society of Denmark, and in the fullest communication and sympathy with the Agricultural interests of the kingdom.

In Germany there are a large number of Agricultural Institutions. North Germany alone has eleven Agricultural Colleges of the highest grade, twenty-nine institutions of a middle and lower grade, and twenty-nine schools for gardeners, vine-dressers. and other specialists, and thirty-five agricultural stations, where experiments in cultivation are made and investigations in agricultural chemistry are conducted. In Southern Germany the number is not quite so great, but is large. It would not be worth while to even name them all. I visited only three.

The Agricultural Museum at Berlin is a most valuable auxiliary for studying agriculture. All the varieties of seeds, roots, fruits and other substances that have been the objects of culture are to be seen here, so too are the animal products from which so much of the farm profits are derived. The varieties of implements which modern ingenuity has devised to shorten labor and improve production are here in great numbers. Here too, the chemist shows the analysis of the products of the farm ; the water, starch, oil, albumen, phosphorus, surphur, silica, potash, lime, &c., of a pound of wheat or other grain, are here exhibited side by side. Days might be spent in the study of this large and valuable collection.

The Agricultural Department of the University of Halle, is one of the highest rank in Germany. It is established and conducted on the assumption that the farmer should have as good a general education as any other citizen, and that the principles of science are the same for all educated men. Hence its students are required to take the university course, and go through as full a series of studies as those in any other department. The agricultural course occupies three years, and is attended by from one hundred and fifty to two hundred students. In addition to the facilities for studying Chemistry, Botany, Geology and other branches of science, there is a small experimental farm, a Botanical garden, a collection of different breeds of sheep, and good arrangements for the study and practice of veterinary science. The examinations are full and strict. It is said that only a few of those who attend, present themselves for examination, and but three or four graduate in a year.

The Agricultural College at Poppelsdorf, also enjoys a high reputation. It was not in session when I was there, but I had an opportunity to see their buildings and appliances for teaching, and also to visit the two experimental farms belonging to the Institution. The students are not obliged to work on the farms, as they are sup-

posed to have acquired the practical part of farming before entering the college. The Institution is exclusively supported by the Government, and the annual expenditures of the institution, amount to twelve thousand thalers. There are fifteen instructors, viz. three in the different branches of Agriculture, two in Chemistry and Technology, and one each in Botany, Physics, Geology, Zoology, Forestry, Veterinary Surgery, Mathematics and Architecture, Gardening and Rearing Fruit Trees, National Economy, and in Agricultural Jurisprudence. The weekly lectures of the several teachers vary from three to seven, and the entire course extends over two years.

Though the students are not practically employed on the farms, experimental courses of chemistry, botany, and physics are introduced, during which the students are employed, with the assistance of the teachers, in solving chemical, vegetable and physiological problems. The teaching is by lectures. The whole premium payable for two years amounts to one hundred thalers, viz : seventy thalers for the first, and thirty thalers for the second year. The lowest age for admission of students is seventeen years, but the greater number of the students are from twenty to twenty-five. The attendance is respectable.

The students are matriculated in the University of Bonn, where they enjoy the same rights as the other University students.

The farm of one thousand Prussian Morgen is interesting on account of the wonderful improvements made in it. In 1861 it was cleared of wood. The soil is clayey and was cold, and having on it a natural growth of birch and small oak. It has been fully underdrained and thoroughly cultivated and enriched. They get all the night soil and street dirt from Bonn, together with the manure from three hundred horses. They are paid by the city of Bonn twelve hundred thalers a year for taking the night soil, and six hundred thalers for the street dirt, and they pay about ten thalers a year for the manure of each horse.

The stock on the farm consists of twenty horses, thirty cows and five hundred sheep. They raise wheat, rye and oats for sale, and these, with the milk and lambs sold in Bonn, bring them a yearly revenue of from twelve to fourteen thousand thalers. The whole expenses amount to about seven thousand thalers and the rent is fifteen hundred thalers. This farm is a most remarkable example of the power of underdrainage and high manuring to change worthless land into that which is productive and yields a large profit. This farm is on the high table land which is back from the Rhine, and the soil is so astringent that it was formerly used for making alum, and the buildings on the farm were first put up for an alum factory. The smaller farm at Poppelsdorf is on the alluvial soil of the Rhine valley, and is rich, productive and easily cultivated.

There are but two Institutions in Great Britian, in which agriculture is taught, one the Royal Agricultural College at Cirencester,

Gloucestershire, England, and the other the Agricultural Department of the University of Edinburgh, Scotland.

The former is a private Institution, sustained by the fees of students. It was established in 1845. At the beginning, its fees were low, and students were expeeted to labor daily on the farm. Under this system it signally failed. The fees were then raised and the requirement of manual labor dispensed with. And they continued to carry on the management of a farm of five hundred acres. Under this system it did not sustain itself though conducted by very able and eminent men. The farm has now been given up and is in charge of a former graduate of the Institution. The college as now conducted, has the very commodious buildings and appliances originally provided for it, and an able faculty. The Rev. John Constable is Principal, and there are Professors of Agriculture, Chemistry, Natural History, Veterinary Surgery and Drawing. It has a plot of thirty acres in use for a Botanic garden and an Experimental Farm, and also has the right to visit and study in full the workings and management of the former College Farm. The charges are £125, ($606, gold) a year which covers all expenses except books. To be admitted the students must be sixteen years old. There are no requirements for scholarship and the attainments of the entering students are not of a high grade. There are two terms in a year, and students are admitted at the beginning of each term; they are divided into three classes, and the course of study extends over two years. It embraces Natural and Mechanical Philosophy, Chemistry and Chemical Manipulation, Natural History, Veterinary Surgery, Mathematics and Surveying, and Architectural and Mechanical Drawing.

The instruction in Agriculture is given by lectures, and by daily practical classes on the farm. Each student is expected to keep a daily record of all the operations on the Farm, and to make himself thoroughly acquainted with the accounts. Those who wish it have special work allotted to them; some taking entire charge of the cattle, and some of the sheep or pigs. The college diploma is obtained at the end of the course by those who pass a satisfactory examination in Agriculture, Bookkeeping, Chemistry and any other one subject selected by the candidate. Besides the printed examination questions, there is a practical examination on the farm and in the laboratory of some hours duration. There were, I think, sixty or seventy students in attendance, and the institution is now a success, pecuniarily, and its graduates are distinguishing themselves, both at home and abroad as farmers, farm managers, chemists, &c. Five hundred thousand acres of land in England are now managed by graduates of this College.

At the visit made there, myself and friends were received by the principal who showed us over the buildings, botanic garden and experimental grounds; and then put us in charge of a student to visit the Farm. This young gentleman went over the buildings, stock-yards

and farm, showing and explaining to us everything of interest in a most satisfactory way. It was an excellent test of the students knowledge, and he did credit to his teachers and to the institution. He explained with a minuteness and accuracy of detail which showed him to be master of his subject. Some competitive examinations of the students have been held by a Committee of the Royal Agricultural Society, for the diploma of that Society, and they came off with high honor.

Agriculture is taught in the University of Edinburgh in annual courses of lectures by Professor John Wilson. The course is open to students attending the other departments of the University, and is intended to be supplemented by the courses of instruction in Botany, Geology, Chemistry, Natural Philosophy, Mathematics and other branches of science, though the attendance in other departments is not obligatory. The course of lectures is in two parts, comprising the Principles and Practices of Agriculture.

"First Division.--History of Agriculture. General purposes of Agriculture—conditions affecting it and scientific principles on which it is based—these comprise the *Chemistry of Agriculture*, including the constituents and Analytical Composition of Soils and of the Cultivated Plants—the Composition and Physical and Chemical Agencies of the Atmosphere and of Water—the composition of Manures, Organic and Inorganic. The *Geology of Agriculture*, including the Formation of Soils, their Chemical and Physical Characters, and suitability for the growth of different crops; their economic or industrial characters. The *Botany of Agriculture*, including crops cultivated for Food and for Technical purposes. Cultivation of forest trees. Formation and management of plantations, &c. The *Physics of Agriculture*, including Meteorology, or the Laws of Climate, Light, Heat, &c., as influencing Plant Life.

Second Division.—The *Mechanics of Agriculture*, and their application to the different descriptions of implements and labor required on a farm. Sequence of Agriculturral operations. Economical division of labor. Rotations of various districts discussed and explained. Improvement of the soil by Draining, Manuring, Liming, &c. Live stock. The *Economics of Agriculture*. Farm Engineering and Construction. Agricultural Policy. General management and improvement of landed property."

There are about twenty-five students in the class this winter; the fee is four guineas ($20, gold). The museums to which the students have access are of the very highest grade. The Chair is supported partly by the Highland and Agricultural Society of Scotland, and the subjects and questions of examination for a degree are prepared by a committee of that society, and the diploma goes out from it. The Professor of Agriculture is a member of their council. The attendance upon the course at the University gives special advantages in preparing for the examination for the certificate or diploma in

agriculture, but the examination is open to all, without reference to the time or place of preparation or manner of acquiring the necessary knowledge. The following are the topics and committees of examination for the present year:

1. *Science and Practice of Agriculture—Mechanics and Construction*—Professor Wilson; George Hope, Fenton Barns; Robert Russell, Pilmuir; and John Wilson, Edington Mains.
2. *Botany*—Professor Balfour.
3. *Chemistry*—Professor Anderson.
4. *Natural History*—Professor Allman.
5. *Veterinary Surgery*—Professor Williams.
6. *Field Engineering and Surveying*—Professor Macquorn Rankine and David Stevenson, C. E.
7. *Bookkeeping and Accounts*—Kenneth Mackenzie, C. A., and Archibald Paterson, Meadowfield.

The examination is both written and oral, and the candidate who passes it receives the diploma of the Society, and prizes are awarded to the most meritorious.

The Royal Agricultural Society of England also grants diplomas to young farmers who pass satisfactory examinations on a selected course of agricultural study and practice, somewhat like the above. It is not yet fixed in its details, but is open to candidates who may be qualified without regard to place or manner of preparation.

The committees of both societies are composed of men of the very highest standing in their calling, and the questions for examination are manly and fair. To obtain the diploma of either is a high honor. The emulation which is excited by this course must be useful to the cause of agricultural education.

One of the greatest contributors to agricultural improvement in Great Britain is John Bennet Lawes, of Rothamsted, Herts, England. For more than twenty-five years he, in conjunction with Dr. J. H. Gilbert, has been conducting a course of thorough and scientific experiments on soils, crops and fertilizers, and has freely given his results to the public as fast as they were proved to be conclusive. Time and money have been spent in the investigation with a liberality and a persistency that is unexampled. Mr. Lawes is teaching on the farm, in the laboratory and through the press, and though he does not meet his pupils face to face, he is probably instructing a larger class of farmers than any other teacher in the world.

It should be mentioned that there are many of the most successful farmers in Great Britain, who consider the best training for their sons to be, first, a good, general education; then two or three years in some counting-house, where strict and methodical business habits can be acquired; then a year or two of residence with some good farmer to learn details of farm management, and he is prepared to begin business for himself.

A review of the varied forms in which agricultural education is

attempted, is only perplexing when looked at in its differences. When considered as an expression of the deep interest felt in the improvement of the most important of all arts, we feel that it is worthy of all the attention it is receiving. It is plain, too, that the differences arise mainly from the different views of men who own or till the soil. The great tenant farmers of England and Scotland, who manage hundreds or even thousands of acres of land, look for their success in a somewhat different line from the small farmers of Belgium, France, and other countries, who till their own little plots, or from those of our country, where men are worth more, and land and money worth less than in the Old World. Institutions must vary to suit the circumstances of the people. A more perfect knowledge of the laws of Nature, a wider, general dissemination of this knowledge among all the people, and a higher grade of general education, are the necessary means to reach the ends which are sought. The first of these has been too much neglected among us because it does not bring money to those who pursue it; the second is, to a great extent, dependent on the third, and the third, much as we praise ourselves and our system of education for all, has never been fully appreciated in the power which it gives for discriminating between truth and error, between the spurious and the genuine. My own opinions of the subject, I think, are clearer from the comparisons made, but I am also more deeply impressed with the wisdom of the action already taken in our country and State. The common school first, the academies and high schools next, and then the colleges and professional or technical schools, must all be sustained by the encouragement of the public and the fostering care of the State, in order to best meet the expressed want of the day. Industry, frugality, and good morals are cardinal virtues which ensure a moderate success to every individual, but the highest successes are only to be secured by those who join to these the greatest efforts of the trained intellect and will.

NOTES *on visits made to farms in various places abroad.*

Steam Cultivation and Ploughing.—Through the favor of Mr. Fowler, son of the inventor of the steam plough, I had an opportunity to examine one of these machines in operation. It was at work on a farm near Uxbridge, a few miles west of London. The field was a wheat stubble, and the soil a hard flinty gravel, naturally dry and unproductive. The field was nearly a quarter of a mile across, the sides crooked and the surface moderately rolling. The implement used was a cultivator, standing about two feet high, triangular in form, seven feet wide, and with nine large and strong tines which would penetrate the ground from eight to fifteen inches. To move this implement there were two ten horse locomotive engines, and with these engines, placed on the headlands at the two ends of the field, the cultivator was connected by a wire rope. The rope was fastened

to a drum on each engine, and when one of these drums was turned by the engine the rope was wound up and the cultivator drawn to it, and then by the action of the other engine, the cultivator was drawn back again, and so on. The engines moved forward each time, over a space equal to the breadth of the cultivator. A man rides on the cultivator, and by proper steering apparatus guides it around obstacles and along crooked places, and also turns it around at the ends. The movement was rapid; the machine passed three times across the field and made the turns in nine minutes, which is equal to nearly five miles an hour, or about twice as fast as ordinary teams move. The ground was thoroughly torn up for ten inches deep; and for a week or more the average work done had been twenty acres a day. It was to be cultivated crosswise, and then to be harrowed twice. The harrow was sixteen feet wide and with thirty to thirty-six long teeth. The land was to be sown to turnips. The machines did not belong to the farm, but were hired, together with the men to manage them, of a person who makes it his business to do steam cultivation, by contract. The price paid was nine shillings an acre, with coal and water for each cultivation, and I think about half that for the dragging. The *cost* is not materially less than if done by ordinary teams, but the *quality* of the work is vastly superior to anything that has been heretofore done by horse power. Besides it enables the farmer to keep up with his work at a time when there is a great strain on the ordinary force of the farm. The farm visited is a large one, twelve hundred acres of it were cultivated last year; this year a still larger area is to be done, and the engines are engaged for three months. The business of steam ploughing is extensively carried on by a large number of enterprising men in England, some of whom own a number of machines and keep them constantly at work. They are much less used in Scotland than in England. Besides Fowler's system of steam ploughing, there is Howards and one or two more, but Fowler's is most extensively known and used. This mode of cultivation may come into use on some of our large farms, but it is not likely to displace ploughing by horse power on our medium and small ones. It has, however, rendered an incidental service to agriculture by showing the benefits of deep cultivation, and the advantages of thoroughly stirring the soil without bringing the subsoil to the surface. Many farmers who still retain the old form and means of ploughing are glad to use steam to cultivate their lands deeply once in four or five years. By steam the land can be cultivated two or three feet deep. Mr. Campbell, of Faringdon, England, this year raised sugar beets on eighteen hundred acres of land, all of which he had cultivated three feet deep. The crop did not suffer from drouth in this extremely dry season, and the yield was a good one.

Experiments with fertilizers at Rothamsted Herts, by Messrs. Lawes and Gilbert.—The long series of experiments which Mr. Lawes has instituted and which Dr. Gilbert has studied chemically,

is one of the most valuable contributions ever made to Agricultural Science. In his park which has probably been in grass for centuries, and certainly has not been ploughed or seeded within the memory of any one living, there are eighteen equal plots of about one-third of an acre each, marked off to be tried with different fertilizers, using the same kind on the same plot every year since the beginning in 1856. One of the plots has never been manured. The whole series of experiments cannot be detailed here, though the results show as plainly on the ground as if they were written with ink. The best crops of hay are obtained from the use of mixed ammonia salts, and salts of potash, soda and magnesia, and they are about treble those on the unmanured plot.

This summer has been an exceptionally dry one, and the hay crop has been almost destroyed in many parts of England. From the unmanured plot in the park, the hay only averaged six hundred weight per acre, while on the plot manured with nitrate of soda, two tons, sixteen hundred weight were gathered, which was the largest rate of produce of any plot. It is interesting too to see the effect of heavy manuring in killing out weeds; there are scarcely one-tenth as many in the plots which were manured with ammoniacal salts as on the unmanured portion.

The experiments with Barley upon the same plots for eighteen successive years are equally instructive. Ammonia Salts, Nitrate of Soda, Rape Cake, Super Phosphate of Lime and mixed Alkalies have been tried in various ways. The unmanured has averaged twenty and one half bushels a year, and that manured with Nitrate of Soda, Super Phosphate of Lime and mixed Alkalies has averaged fifty and one quarter bushels for the entire period.

The wheat has also been continued every year for twenty-six years, on the same ground. The unmanured land has averaged fourteen and three quarter bushels; that manured with barnyard manure, thirty-five and a half bushels; and that manured with mixed Alkalies, Super Phosphate and Ammonia Salts, thirty-nine and one half bushels an acre. The experimental plots for beans, peas and tares, and for clover are equally interesting and useful; so too are the experiments in the laboratory where they seek the reasons for the effects observed. A whole building is filled with the samples of grain, straw, soils and manures which have been used by Dr. Gilbert, in his laboratory work, and the long series of specimens collected in the inquiries on the sources of nitrogen in plants and on the feeding of animals; the whole representing the labor of several men for a quarter of a century, and the expenditure of many thousand pounds sterling; all in pursuit of theoretical truth. The agricultural world owes a debt of gratitude to the men who thus labor to serve them.

The Fen Country.—There is a large tract of land in Cambridgeshire and Lincolnshire, lying about the mouth of the Ouse and Nene rivers, which is known as the Fen Country. It comprises

about three hundred thousand acres of land that was formerly wet and swampy, and so flat, that the portions which had been made into meadow were liable to be overflowed and the crops destroyed. There were patches of hard ground scattered at intervals throughout the country, but the whole region was poor, sickly, and in disrepute. In modern times it has all been reclaimed from the waters, the swamps are drained, the meadows have become wheat fields, and the former meres or ponds are now dry land. Immense ditches have been cut to carry away the water, and both wind mills and steam engines are employed to pump the water from the land into drains. With the removal of the water, the land has settled, both by compacting and by decay of vegetable matter, so that much of the surface is now from twelve to twenty feet below high water mark, and the tide has to be shut out by dams and sluices. The history of this work fills two large octavo volumes, and the work itself has taxed the skill of the ablest engineers of England. It is, however, successful, and the whole country is as rich as a garden. One day was spent about Chatteris with Mr. Alfred S. Ruston, a prominent citizen and farmer there, learning the mode of managing the Black Fens, as those in that vicinity are called. They are full of organic matter, and to make them yield crops, the farmers dig pits or trenches down to the hard bottom, and then throw out enough of this earth to make a good dressing. Such a trenching costs seven or eight dollars an acre, and makes the land sufficiently rich to bear crops for eight or ten years, when the operation must be repeated. Enormous crops of wheat, barley, oats, cabbages, mustard and carrots are raised upon this land, and at smaller cost than they can be on upland. The land here is occasionally plowed to an extraordinary depth. A common plow drawn by two horses goes first, and then a great plow drawn by six, eight or ten horses follows and turns up a furrow slice thirty inches deep. The practice is found to be beneficial. This black land still needs manuring, and super-phosphate of lime does wonders on it in increasing the crops. The profits of the farmers here depend much more upon the sale of crops than upon the fattening of sheep or other stock. It appeared as if half the whole land was in wheat, oats and barley, and the crops were uniformly large beyond anything I had ever seen.

Another day was spent in examining the drainage works and the lands nearer the mouth of the river Ouse. One of the great drains running into the river Ouse, dug for carrying out the system of drainage, was dammed and provided with large sluices so that it might run the water off at low tide and prevent the flood from coming in at high water. From a bad foundation or other cause this dam was undermined and carried away some eight or nine years ago, and thousands of acres of highly improved farm lands were laid under water. To remedy this disaster at once, a solid and permanent dam was built entirely acros the drain. This dam is so high that the tide

rises and falls on the lower side of it twenty-six feet, and in dry weather the water in the drain is nearly down to low water mark. The water from the drain is carried in syphons directly over this dam, and run off into the stream below. Sixteen syphons, each three and one half feet in diameter are used, and they have for several years proved sufficient to carry off all the water. It was heroic treatment of the difficulty which was abundently justified by its success, and it is now a wonderful sight to see this good sized river running with a lively current up to a solid dam and then appearing on the other side in an equally lively stream running off towards the sea.

The lands near the sea have been filled up with sediment from the water, and are inexaustibly rich, needing neither trenching for clay nor deep ploughing to bring up the lower soil.

Fertilzers are employed on the soil with good effect, and stock can be kept with profit. The surface of this Fen Country is flat and uninteresting, and is usually avoided by tourists, but it is rich and productive beyond any upland, and much as its improvement has cost, it pays a large profit. And though formerly famous as a locality for fever and ague, it is now, by the drainage, rendered as salubrious as any upland.

The dyked lands of Holland were also visited, and full notes made of their management and produce; the results of the long trials of the value of the Ayrshire and common cows in Norway and Sweden were obtained. The great beet sugar farm and factories at Halle, was inspected. The remarkable ring ovens or annular furnaces of Hoffman, for burning lime and brick were examined in Prussia; dairies were visited in Sweden and Holland; some of the model farms of England and Scotland were visited; and observations made and impressions received whenever opportunity allowed. It is too late in the year to write them out in detail for this report, and they must be reserved for a future publication.

I should not omit to make public acknowledgment of the favor I have every where enjoyed for pursuing my inquiries, and the kind opportunity which is allowed me by many intelligent gentlemen to continue those inquiries by correspondence. I hope the results attained may be useful to the state, and may enable the Agricultural College to better fulfil its purposes in the State.

RUTGERS' COLLEGE, New Brunswick, December 12, 1870.

REPORT

OF THE

BOARD OF VISITORS.

REPORT.

To His Excellency, Theodore F. Randolph, Governor:

The Board of Visitors of the New Jersey State College for Agriculture and the Mechanic Arts, beg leave herewith to transmit the Annual Report required by law to be made by them.

The Board visited the institution at New Brunswick June 16th, 1870. The second meeting of the Board is appointed to be held December 20th, 1870, and cannot, therefore, be included in the present report. The Board, at its meeting in June, made an unusually thorough and extensive examination of the details of the institution. They attended the examinations of the several classes in the studies which they had been pursuing during the preceding term. They received reports from the President and Professors in regard to the studies of the classes, and the progress which had been made. They witnessed the military drill of the department under the Military Superintendent, Colonel Kellogg. They inspected the arms and accoutrements which have been issued by the Quartermaster General of the State to be used by the State College. In all these respects, the Board takes great pleasure in reporting that they were perfectly satisfied.

The Board also heard the Thesis of the graduating class read, and selected the best and second best from the number. The best was adjudged to be that of Mr. William Clark, of Mattawan, on "The Railway Bridge at New Brunswick," and the second best, that of Mr. C. C. Haven, of Trenton, on "Pneumatic Transportation."

The following resolutions were adopted at the meeting of the Board:

Resolved, That the examinations witnessed by the Board have been in the highest degree satisfactory, and evinced the earnest efforts of the pupils and their instructors in their work; and that the Thesis of the graduating class had shown a maturity and readiness in applying their knowledge, which was gratifying.

The death of Mr. Seth Boyden, which had occurred since the last meeting of the Board, having been announced, the following resolution was unanimously passed, and ordered to be recorded in the minutes:

Resolved, That the Board has heard with deep regret of the death of their associate, Mr. Seth Boyden. As a man of great practical sagacity, and possessing in an unusual degree the capacity for applying science to new and valuable uses, his life was highly serviceable to his country and his time. As a friend of education, especially of scientific education, his influence was always freely used in behalf of institutions of learning. This Board knowing the interest he always felt in this institution, and his intelligent exertions in its behalf, desire to put on record this estimate of the value of his life, and their sense of its loss in his death.

A committee of the Board, consisting of Mr. Hendrickson, Mr. Parry, Mr. Thompson, and Mr. Ingham, was appointed to visit the College Farm, and devoted the afternoon of July 15th to this object. The farm is under the charge of George H. Cook, LL. D, the Professor of Agriculture. They made the following report of their examination:

The committee are much gratified in being able to report a very great improvement in the appearance of the farm since it came into the possession of the Agricultural College. Fields, which but two or three years ago were an unsightly swamp, having no value, are now beautifully and heavily covered with clover, or set in corn of good growth and healthy color, promising a good product. In every part of the farm they notice a corresponding improvement, all the growing crops showing the effects of the judicious application of manures, and most interesting results of varied experiments.

When the farm was purchased by the College it would have been difficult to find a more unpromising tract of land. Considering its condition at that time, and the few years it has been under the direction of the Professor of Agriculture, the improvement is almost incredible. The success of his system and labors should and must have a most beneficial influence upon the agriculture of the State. For, if barren fields and impassable morass can, by the application of muscle directed by brain, be brought to so high a state of cultivation, what may not the same appliances do for the already partially improved lands of the State? It would be well for the farmers of the State to visit this farm. Although it is considered by the Professor to be only in the transition state, we, as agriculturists, do point to it with the greatest confidence as an example that may profitably be followed by all.

It is much to be regretted that the Legislature has not made ample provision for the even more rapid improvement of this property, instead of throwing, as they have, all the expense of its development on the College. There should be a liberal annual appropriation for the purchase of stock, improved implements, and more extended experiments. As a farm, it will very soon be self-supporting; but as a *model* farm, it should not be required to support itself. Every man who works the soil should be able to learn something in his own par-

ticular branch, whether it be in cereals, in fruit, in vegetables or in stock. Looking at it from this standpoint, we believe the amount of money required for this purpose might be so appropriated by our Legislature with more general benefit to the people of the State than in any other way.

At this same meeting of the Board a communication was received from the Faculty of the College, recommending that the Board of Visitors, in connection with the Board of Trustees, take action to extend the Course of Study to four years instead of three. The reasons adduced for this extension were set forth, viz.:

1. That the present time of three years was really too short to permit that thorough training in the branches taught which the plan contemplated. This is especially the case in those subjects requiring much practice in manipulation, as in practical surveying and engineering, and in analyzing and assaying in the Laboratory.

2. It would be unwise to demand a higher standard of preparation for entering the College than that now required, because, being a State institution, and designed for the benefit of all parts of the State, it would be unjust to put its requirements for entrance beyond the reach of young men prepared in the common schools of the State.

3. It is proposed in the plan of study submitted, to make the course of the first two years so far complete in itself, that students who cannot remain a longer time may leave at that time with a reasonably good education. Those who after that remain during the whole course, can then be trained in the most thorough manner, and carried through the more abstruse and difficult branches of engineering, chemistry, and agriculture. In this way any objection to the plan proposed, on the ground of its making the Course of Study too long, may be obviated, and still the efficiency of the College greatly enhanced.

Acting on these considerations, the Board adopted the following resolutions:

Resolved, (if the Board of Trustees concur,) that on and after September, 1871, the students entering the Scientific Department of the College be required to pursue a course of four years, in order to receive the diploma of Bachelor of Science; but that the Faculty be authorized to grant a certificate to such students as shall pursue satisfactorily the first two years of such a course.

Resolved, That the schedule of studies for the Scientific Department submitted to the Board by the Faculty, arranged on a basis of four years, is hereby approved, and the Faculty authorized to carry it into effect with the class entering September, 1871.

The schedule is briefly as follows:

FRESHMAN YEAR.

Algebra, Geometry, Trigonometry and Draughting.
Physiology, Zoology and Botany.
Rhetoric, English Literature and History.
French.

SOPHOMORE YEAR.

Surveying and Levelling, with field exercises. Descriptive Geometry. Elementary Chemistry.
Elementary Mental Philosophy.

JUNIOR YEAR.

Analytical Geometry, Calculus, Mechanics, Natural Philosophy and Astronomy.
Constitution of the United States. Political Economy.
International Law. German.

SENIOR YEAR.

Mechanics and Engineering.
Geodesy and Architecture.
Chemistry and Geology.
Moral Philosophy.

At the beginning of the Junior Year students have the option of taking the *course of Analytical Chemistry and Agriculture*, instead of the course of Civil and Mechanical Engineering. In that case the student takes Chemistry and Laboratory practice, and Agriculture, in the place of the higher mathematics, and Engineering and Mechanics, in the above course.

All of which is respectfully submitted.

WM. H. HENDRICKSON, *President.*
WILLIAM PARRY, *Secretary.*

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